



A. R. Frost

North American Lepidoptera.

The

Hawk Moths of North America

by

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TO
Prof. WILLIAM SAUNDERS, F. R. S. C.
OF LONDON, ONTARIO,

*Author of numerous and most valuable writings on American
Entomology, both practical and scientific, Editor of the
Canadian Entomologist,*

this work is most gratefully dedicated in remembrance
of many kindnesses bestowed by him upon his obliged
and life-long friend and fellow-laborer,

THE AUTHOR.

Books of natural history aim commonly to be hasty schedules, or inventories of God's property by some clerk. They do not in the least teach the divine view of nature but the popular view, or rather the popular method of studying nature, and make haste to conduct the persevering pupil only into that dilemma where the professors always dwell.

Thoreau.

On Collecting and Preserving for the Cabinet.

In des Papillon's Gestalt
Flattr' ich nach den letzten Zügen. —

Goethe.

Nature, like Virgil's sorceress, incessantly repeats, enchanting: *Ducite, ab urbe domum, mea carmina, ducite Daphnim!* and brings us by many lures to her home in wood and field. Under the spell exercised by the display of Butterflies and Moths, we may behold the Entomologists, chasing their treasures by day through the meadows, in the evening waiting for them by beds of scented flowers, at night watching by bait and light the coming of their tiny prey. The study combines Art and Science in a peculiarly seductive manner. Even in flowers we have no more beautiful patterns and colors and here these may be preserved for the most part perfectly and for a life time in a Collection. Tints which we do not find in Art often brought together, are here harmoniously blended, as the blue and green in the Wandering Hawk Moth, *Argus labruscae*, and the pink and yellow of the Rosy Dryocampa. The moths afford superb instances of the blending of neutral tints, unspeakably soft browns and grays, as in the *Smerinthinae* and the "False Hawk Moths", the species of the Bombycid genus *Apatelodes*. These two, *A. angelica* and *A. torrefacta*, are remarkable for their casual resemblance to certain unocellated *Smerinthinae*, no less than for the delicacy of their shaded neutral colors. It is owing to the natural constitution of the human mind, that it is pleasantly occupied in observing the different forms, in solving the many questions

which the structure and lives of these tiny creatures suggest. In the case of the Indo-Germanic peoples there is, to aid this, a decided tendency to the study of Natural History, to investigate the material constitution of the world in which we live and of which we form a part.

Collecting with the net over flowers in the evening, when the Hawk Moths are active, is a very alluring pursuit. Verbena beds, where the flowers are of the white variety, against which the hovering Moths are more easily seen, I have found very productive. An intelligent and charming writer, Mrs. C. H. Fernald, has given us a list of the cultivated plants attractive to these insects. I may be forgiven for quoting her words: „Most people love flowers and cultivate them for their beauty and fragrance, but to collectors of insects some of them have a double charm, for they attract some of the most beautiful and rare *Lepidoptera*. The common lilac, *Syringa vulgaris* and the Tartarian and Siberian Honeysuckles, when in full bloom, during the hottest hours of a bright, sunny day, are a perfect paradise for several of the *Lepidoptera*, as well as numerous *Hymenoptera* and *Diptera*. The gaudy *Papilio turnus* sails proudly over the highly scented flowers, frequently dropping down to sip the nectar; and *Hemaris diffinis* and *thysbe*, with an occasional *gracilis*, whiz about the flowers as "busy as the bees." Then, at twilight, the larger Sphinx moths, *gordius* and *chamaenerii*, and rarely *luscitiosa*, dart swiftly from shrub to shrub, and from flower to flower, requiring a quick eye and hand to capture them. *Heliophila albilinea*, *Plusia simplex*, and *precatonis*, and occasionally a *bimaculata* are also taken on these flowers. I have captured more insects on *Oenothera Lamarckiana*, than on any other plant. A plot about three feet square gives from fifty to one hundred fresh flowers about four inches in diameter every evening, and if the seed pods are picked off, they may be kept in bloom for three months." In addition to the *Oenothera*, or Evening Primrose, of which Mrs. Fernald writes, my kind friend Mr. L. W. Goodell of Amherst, Mass., notes the cultivated varieties of *Datura*, Mignonette, Alyssum,

and Pinks as being very attractive to Moths. On Staten Island, where the wild *Datura stramonium*, or Jamestown Weed, is common, I have taken several Hawk Moths on its white and purple flowers. Also on different sorts of *Asclepias*, or Milkweeds, the leaves of which are eaten by the larvae of *Danaus plexippus* and *Euchaetes egle*, and are generally very attractive plants to bees and beetles and butterflies.

In taking Moths with the net, the poison bottle should be kept handy and the insect introduced into it as quickly and dextrously as possible, to prevent injury to the wings and especially to the fine fringes which are easily abraded in fluttering.

The action of chloroform being very rapid, I have used a bottle, fastened to the cork of which (inside) was a small bit of sponge, which I kept moistened with this anaesthetic. Into this bottle I introduced the insects from the net, transferring them in a few moments to the cyanide bottle. They hardly fluttered and the fringes were preserved. Some collectors use a needle fastened in a little wooden handle as an implement for impaling Moths resting on fences, trunks of trees, in the daytime. The pinned Moth is then quickly introduced into a small close box in which a chloroformed sponge is fastened. The pin must be carefully used so as to transfix the moth through the center of the thorax and avoid destroying the thoracic tufts. If this method is objected to, the resting Moth may be covered by the chloroform or cyanide bottle. As cyanide is a deadly poison, too much care cannot be taken with it. A solution of arsenious acid and nicotine (extract of tobacco) may be used to kill larger moths; the pin used for the specimen being first dipped in this solution. It has been also recommended to use a hypodermic syringe to introduce poisons. I myself have only used the two sorts of bottles, chloroform and cyanide and which have answered the purpose sufficiently well. Individual experience must determine the best methods.

The operation of setting Moths for the Cabinet is one requiring great nicety and care. The specimens must not be allowed to get too dry, as then the wings cannot be

brought into the required position without forcing them too roughly. The long German pins, made especially for the purpose should be used, and setting boards of soft pine wood of different sizes must be kept in readiness. Black or silvered pins are the best to use. In Germany the Naturalist shops sell setting boards of which the two sides are fastened by moveable screws, so that they can be shifted to suit the size of the insects. They are about a foot long, a convenient length, with cork beneath for the pin to enter. A well set Moth should have the hind edge of the forewings on a line with the thorax behind, and the hindwings brought up so as to leave the abdomen free. The wings may be fastened by strips of glazed paper fastened by pins, and the wings should be carefully brought into position by a stout bristle fixed in a handle and applied against the veins of the costae, so as to avoid making holes in the wing itself during the operation. In this, as in all pertaining to the practical side of the study, experience will suggest many things to the collector, who will naturally take pride and interest in having his specimens look well.

The best months for hunting the larvae of the Hawk Moths are July and August; and one of the most prolific spots, a vineyard.

Caterpillars may be prepared for the Collection in their various stages to illustrate the growth of the species. For this purpose they must be first killed by being placed in a chloroform bottle. The dead caterpillar should then be placed between two pieces of blotting paper and, by a gradually encreasing pressure of the fingers, the contents of the body expressed out of the anus, so that at length nothing is left but the empty skin like the finger of a glove. Care, by avoiding sudden and unequal pressure, must be taken not to break the coloring cells of the skin; with the best of care, however, green caterpillars lose their color under the operation. The empty skin is then to be fastened, by the introduction of a small tube in the vent, to an india rubber inhalator (such as can be had at any drug store) and forcing the empty skin gently full of air, keeping it

distended till dried over a "stove". A tin box with one end out makes a very good impromptu "stove", which must be used in drying the inflated skin. An alcohol flame held under the box (I have used a seltzer-powder box attached moveably to a stand so that it could be removed from or approached to the flame) heats the air within it and the caterpillar, being introduced through the open end, must be kept inflated, by the rubber inhalator until dried. With a common insect pin, introduced through the dried and protruding intestine, the specimen may be pinned in the cabinet. Caterpillars so prepared may be also artificially colored, but as a rule, with care in the preparation, which needs practice, this is not necessary. Pupae killed by heat may be also pinned (after a thorough drying) in the collection.

As to a cabinet, some collectors prefer one with drawers having a cork lining. I remember that I was astonished when in the Cambridge Museum to find that Dr. Hagen used no lining at all, forcing the pins into the soft pine bottom of the drawer itself. But I think no lepidopterist would avail himself of such a plan. As it was, I noticed that many of the frailer types of Zeller had become broken; the points of the pins blunting or breaking off and the specimens suffering under this treatment. In Germany turf and other cheaper materials are used as a substitute for cork. All this may be left to the choice of the collector. The plan upon which I proceeded, was to make boxes, of a book shape, being a little longer than wide, having a pane of glass for the top and one for the bottom. The glass was fitted in a morticed frame and fastened in position by three-cornered bits of tin such as glaziers use. The boxes were about 12×14 inches, but their size is a matter of taste. The frame must be fully $2\frac{1}{2}$ inches deep clear of the glass, to prevent the heads of the pins touching the same. After fastening in the bottom glass, I arranged small fine cut corks at regular intervals in the box, guiding myself by a sheet of ruled paper beneath, and fixing the corks by means of a cement made of goldsize and red lead. Mr. W. T. Davis

informed me that Stratena, a common cement, answers the purpose very well. The intervals between the corks are regulated by the size of the specimens to be placed in the box. When the box is filled, each specimen carefully pinned in the center of its cork, the top glass may be fitted and fastened in the frame and the edges pasted over with strips of paper to exclude dust and mites. The advantages of this method of preserving the collection are, that both surfaces of the specimens can be viewed without opening the box; that dust and insect enemies, such as mites and *Anthreni*, are guarded against without the use of poison. These boxes are also very cheap and can be simply arranged on shelves like books. When filled and the specimens are to take their definitive place in the collection, the glass can be permanently closed and a list of the contents with the Family name at the head pasted at the back of the box. The objection that the specimens cannot be readily gotten at is outweighed by the consideration that they are adequately preserved. Specimens which are the subjects of study can be kept *ad interim* in store boxes. So long as I kept my specimens in such glass boxes, I never lost a single one from museum pests. If an infected example was by any accident introduced, the damage was always confined to the infected specimen. The *Anthrenus* larva would fall and, owing to its inability to crawl on glass, would perish before reaching a second specimen. The French Entomologist, the late M. Guenée, used to keep his types in smaller glass boxes of a similar construction for their better preservation, and I had the opportunity of seeing them at his house in Chateaudun. Each specimen should have a locality label attached to the pin and the bottom specimen of a series should bear the correct Latin name and the Authority; written labels are, as a rule, better, being more evidently authentic, than printed ones. The collector can pass many happy hours with his specimens, microscope and notes, and happy hours are always welcome in this life.

Collecting at Night has the drawback that one never knows when to stop and go home to bed, seduced by the

mysterious silences and shadowy vistas in the woods. Even when the moths will no longer come to bait, one lingers, waiting for some revelation. The moon has transformed the prospect and in its weird light an uneasy spirit seizes one to adventure farther yet. Beyond that tree, half in gloom and half clothed in gauzy light, some forbidden procession moves and we have forgotten our entomological quest in remembering nursery tales and catch ourselves hoping to meet the Old World Fairies, as if they, too, had emigrated, under the pressure of these bad times of incredulity perhaps. But oftenest I turn the shadows into Indians, and when the Whip-poor-will is suddenly silent, I believe they are coming at length, with King Phillip leading the last hope of these ghosts who rebel at fate in their red graves and at the order of things, the white man with his physical rifle and intellectual cannon of Evolution among other. And then my favorite Indian of them all, Wannalancet, warns me again in time and I rout all these spectres, resolving them back into their true shape with the heartless magic of reason. But I have often been out all night in the woods, and slept, too, in my blanket by a little fire, as good an Indian as any of them. As such time I was not concerned chiefly about moths. I was curious to find out what happened and how the world got along in the dark. It seemed on the whole very well and without any necessity for a doctor. In the dead of the dark, the pale Queen of the Night (*Actias Luna*) swept by me, with the green moon-light reflected from her wings.

A strange life these insects lead and one feels like asking the winged butterfly if it has any recollection of the time when it crawled about as a worm, or clung tenaciously to a leaf or branch, the very opposite of this final fantastic life in the ether. And, again, if it remembers the days which it passed cramped together in its chrysalis:

..... Turpi clausus in arca, contractum
genibus tangas caput

awaiting, mummy-like, with patience, its day of deliverance.

The early Dawn is a profitable time for the collector of Lepidoptera, who may then surprise the moths on their

first resting places after the fatigues of the night. On Staten Island my early rising was rewarded by many captures at the hour when the Cat Bird sings and betrays, to none but chosen ears, her relationship to the many-tuned Mocking Bird of the South. Later in the day she utters but the peevish cry which has suggested the common name. On one such occasion I discovered, resting on a wild vine, which grew on the South Beach near the sand and the waters of the Bay, a pair of of the Great Green vine Hawk, *Philampelus pandorus*. One, I took, but the other escaped me, flying directly over the Bay and out to sea. So far as I could watch its arrowy flight, over the smooth expanse of ocean, it kept its course towards the Atlantic, cleaving the saffron colored air, now turning golden under the rays of the rising sun. These are tinier *thalassiphilae* than the Sea Swallows. But the sea gathers in all such wanderers, with other, larger prey. They go gaily for a time but the wave beneath is endless and receives them at last. However, channels, rivers and bays are safely crossed by our Butterflies and Moths. Farther up towards the hills, on the rocky bed of a brooklet, I found specimens of that moth-like butterfly *Fenisecca Targuius*, abroad early but yet sleepy, still carrying into the New World the memory of the rapacious Roman of the Old, no doubt with miniature sins of its own to answer for. My specimens from the Middle States led me afterwards to unite *Porseenna* of Scudder as not different and a certain odd impression, that we had to do with a masquerading moth, to study its structure and make the new genus for it and take it out of the company among which Boisduval had scientifically classed it. Thus certain hours and places, lanes, along which the green tiger-beetle flew up ever and anon before my boy's feet, marshalling the way that I should go, come back to me again out of the years of my early studies, intoxicating my memory. Poe says that joy is not gathered twice in a life, as the roses of Paestum twice in a year. But I gathered then so much that it lasts until now, when world-griefs hold me fast.

In the Hawk Moths the species are all usually readily separable. I have shown in the Lepidoptera the existence of *Progenera*, that is of generic groups of forms which are nearer related to each other than is usually the case; which are, perhaps, in some stages of growth undistinguishable. Such genera are *Hemileuca*, *Datana*, *Nadata*, etc. We may conclude that these species are of recent separation. In the Hawk Moths such instances may be offered perhaps by the typical group of *Hemaris* and again by *Enyo*. The necessary studies on this point are, however, wanting. We may regard theoretically all species as only relatively stable; practically we have to find out the cycle of reproduction and be guided by these results in our nomenclature.

Butterflies and Moths can be collected every where in the habitable globe. Even the Arctic regions are not without their species, while it seems likely that certain Moths still show themselves in the farthest North when the Butterflies have ceased to fly. With a change of Continent we have also a change in the kinds of insects. As we approach the Tropics, Butterflies and Moths become more plentiful in kinds. But, even in the same degree of latitude, there is a difference in the numbers of the individual species to be observed in different quarters of the globe. Thus it has always seemed to me that Butterflies and Moths were more plentiful in America than in Europe. And, as a whole, I think the American Lepidoptera are gayer, more beautiful and certainly more numerous in species. In this connection I remember what Linnaeus wrote about American plants: *Nescio quae fatio facies laeta glabra plantis Americanis!*

While I am writing this in my European exile, I hear a fluttering at my window and I see that a specimen of the "Kleine Fuchs", as the Germans call *Vanessa Urticae*, has strayed into my room and is beating against the window pane. The sight of this species recalls to me the fact that I am far from home. I have just interrupted my writing to open the window and let it out and I noticed, as I did so, that my neighbor, the Poet, was in the garden

gathering inspiration from the Roses. He repeated to me his verses :

Die Rosen gehen auf
 In dieser Sonne,
 Auch du gehst auf, mein Ros',
 In Lebenswonne!
 Entblättere nicht zu früh,
 Halt' 'was zurück,
 Die Zeit die geht zu schnell,
 Zu schnell das Glück!

Poor fellow! With a few gray hairs already visible under his cap, he sings of Youth and Love! I have another neighbor here, the Musician, and we live quite happily, respecting each other's foibles and having a large bond of sympathy in common, as might be expected from a Poet, a Musician and a Naturalist. I shall read this chapter to them, if no more than from a system of revenge for having myself been obliged to listen to a poem and a song which they have recently produced.

Bremen, July 19. 1886.

A. R. G.

The Species of North American Hawk Moths.

The Authors who have written extendedly upon the North American Hawk Moths, or *Sphingidae*, are Harris (1839), Walker (1856), Clemens (1859), Grote und Robinson (1865), Boisduval (1874), Butler (1876), Grote (1877) and Fernald (1886). Of these Walker, Boisduval and Butler have described our species in connection with those from other parts of the world. Since 1865 groups (sub-families or tribes) have been recognised, although these were more or less distinctly indicated and in part named by older Authors, in particular by Hübner. Unidentified descriptions are discussed by me in Papilio, 2, 170.

In the present work*) I have gone over my notes and earlier papers on the family, maintaining my sequence of the genera, which had been in the main recognised by Butler. My manuscript was intended as a chapter of an extended work on North American Moths, which awaited a publisher, when the appearance of Professor Fernald's pamphlet upon the "*Sphingidae* of New England", induced me first to send my list of the species to the "Canadian Entomologist" for publication and then to revise the descriptonal

*) I refer the student to my monograph of the *Sphingidae* of Cuba published by the Entomological Society of Philadelphia, August, 1865. Extra copies of this (with the Plates colored and my family crest on the title page) are now very rare. This paper, written in my twenty third year, was followed by a Synonymical Catalogue of North American *Sphingidae*, including Mexican and West Indian species and a Plate, by myself and Mr. C. T. Robinson, in which the synonymy of our species (which had been mainly taken by Clemens from the British Museum Lists) was originally investigated. Also to papers in the Lyceum Annals, New York; and, later, in the Bulletin of the Buffalo Society of Natural Sciences.

part of my work by the light of Professor Fernald's researches, which were so extremely valuable from the new characters used and which often vindicated my previous generic separations. So completed, the work is here offered to the student. It embraces a few forms not occurring in New England and, although not so full in its account of the species and groups, may not be without sufficient interest as to warrant its issue as a work of reference.

The *Sphingidae* are a highly organized and specialized assemblage of Moths or Night Butterflies, having smooth, hairless larvae and seem to me an outgrowth of a spinose or bristly haired larval group, the posterier spine or caudal horn being developed probably from one or more spines or bristles, the base of which has been prolonged and stiffened by deposits of chitine. In form and structure I believe they are nearest related to the *Ceratocampinae* a subfamily of *Bombycidae*, and separated from allied Saturnian genera (such as *Hemileuca*) by myself and Mr. Robinson in 1866. The *Smerinthinae* are probably descendants of the oldest forms of the *Sphingidae*. On one side they may have given off the higher series, *Choerocampinae*, *Macroglossinae*, on the other to the lower, *Sphinginae*, *Acherontinae*. The anal horn is a simple thin black spinule in *Dryocampa rubicunda*, the lowest form of *Ceratocampinae*, stouter and more developed in the higher *Anisota stigma*, and becoming, with the entire armature, complex and well developed in the higher genera of the subfamily such as *Citheronia*, *Sphingicampa*, *Eacles*. The bristles are gradually lost as the caudal horn became variedly formed. The pupation is similar, beneath the surface, without cocoon, an unusual one in the *Bombyces* or Spinners. Very interesting is the discarding of the larval horn in the later stages in certain genera of Hawk Moths and the substitution therefore of a raised ocelloid spot. That it should occur in two grape-feeding genera *Thyreus* and *Philampelus*, warrants me in associating the two groups in which it happens. The point of my arrangement in fact lies in considering the *Choerocampinae* as next to the *Macroglossinae* and following them by the *Smerinthinae*, to which

I give a central position. I find among the North American genera evidence from which I follow this latter group with the *Sphinginae*, terminating the family with the *Acherontinae*, a tribe not found in the New World. It will be seen that I do not agree with my friend Butler that the *Cossinae* are at all nearly related to the present group. With the *Hepialinae* (from which I separate them while Packard keeps the two together) I believe the Goat Moths to be very low *Bombyces* and Butler himself points out antennal features which warrant this view of their structure. I should not consider the resemblance between my genera *Prionoxystus* and *Lepisesia* as being more than casual.

When coal was being formed, there were probably already differentiated the progenitors of modern Butterflies und Moths, nocturnal creatures, obscurely colored and banded, perhaps with aquatic larvae and active pupal state, living in those literally darker days of the world's past. The gayer tints came in their endless diversity with the daylight and the flowers, probably differentiating comparatively rapidly. From the Moths, the Day Butterflies proceeded, under certain conditions and in certain localities. So far we may be safe with our imaginative science; but, when we come into the region of exact details, we are at fault, the story of all this development can only be guessed at, traced by the steps which have been impressed on the structure and ornamentation of the larvae and perfect insects. Probably whole families have become extinct; in the North American *Paleohesperidae* are the few survivors of such an extinct assemblage, lying between *Castnia* and the lowest Butterflies. With the *Lepidoptera*, as with all life, there has been the same remoulding force at work, but these frail creatures seem to have escaped, by their very lightness, some of the grinding processes of time and circumstance. According to Scudder, a specimen belonging to the *Sphingidae* has been found in amber; I have seen no mention of other fossil remains of this group. This group of Moths must have been influenced by flowers in their development to a large extent. The distribution of Butterflies and Moths is assisted by wind currents

and rivers, by valleys and by plains sheltered by trees. It is impeded by mountains, deserts and the ocean. We have, in North America, essentially one and the same general Fauna, until we reach the Tropical Insular Fauna already colonized in South Florida, and, in the west, the Tropical Continental Fauna which stretches upward from Mexico into Texas and the South West Territories, while, on the high lands of Mexico, it is probable that members of our Temperate Fauna drift down. Yet the Rocky Mountains, the back-bone of our continent, has influenced a West Coast fauna which, in several cases, has preserved more features of the former Arctic fauna from which the European is also descended. There is a constant flux of species from South to North during the Summer of the year and in this way we have received many tropical visitors whose foothold in our colder climate is more or less precarious and uncertain. The question of wintering comes up, which these summer insects are not accustomed to discuss and cannot practically solve. Hence the Cotton Moth (*Aletia argillacea*), notwithstanding all its ravages, does not hibernate successfully over most of its territory; the line of its successful hibernation not having been ascertained as yet and this point in its Natural History, so necessary for the Practical Entomologists to know, is neglected in the Reports I have yet seen. The larvae of the *Sphingidae* have not yet received a comparative study, although most of them are known; the descriptions should be drawn up commencing with the thoracic segments 1—3; then abdominal 4—12; the head should be described by itself; mere descriptions, however full, without comparisons are tiresome and hard to understand.

At mid-day the Bee Hawks, *Hemaris*, may be taken on flowers as well as probably all the Macroglossians with entire wings such as *Lepisesia*. Those with angulated wings, *Amphion* and *Thyreus*, also in the dusk of evening. I have taken also the higher genera of the following tribe, *Deilephila*, *Philampelus* in the day, but the *Smerinthini* and *Sphingini* are crepuscular and nocturnal in their habit, so far as I know without exception. There is then a correlation between

habit and structure and the higher, cocoon-making forms, have a tendency to overstep the usual behavior of the *Heterocera* and become day-fliers. Few occupations are so attractive to the collector of Lepidoptera as the study of Hawk Moths, from the size and beauty of the specimens. Comparative studies are now needed; lengthy and detailed descriptions of the different stages are scattered by various hands in our literature, but they are undigested and to a certain extent unused, if not in themselves useless.

As compared with the Hawk Moths of other Continents, the North American species suggest several points of interest. And first, the ancestry and origin of the group may not unlikely be determined in our fauna, as I have pointed out, by the study of such oldfashioned Moths as are our Dryocampians. The somewhat remarkable larva of *Atreus plebeius*, found by me on Staten Island on the common Lilac, a cultivated shrub, first led me to a suggestion of this origin taken in connection with the larvae of *Dryocampa*, *Anisota*, of which I found three species on oak, and of *Eacles*, which I found on horse-chestnut. Already in 1865, I venture (*Sphingidae* of Cuba, p. 5) to make some generalizations on this head and subsequent studies have only confirmed my belief that in North America are survivals of older groups of *Lepidoptera* to be found, which will throw light upon the genealogy of the present families. I draw attention on that occasion to the larva of *Ceratonia*, and the late Benj. D. Walsh, who wrote me some interesting letters at a later date, has made some valuable remarks on the structure of the larva of *Sphingicampa*, although his breeding experiments on this species, *bicolor*, were defectively conducted as, years ago, I fully explained. Later writers often overlook papers issued some years back, a piece of inexcusable inattention.

When we study the general distribution, it is seen that the higher groups are rather fuller and better represented in the Old World; while the gray, moth-like *Sphinginae* maintain in the New World a larger number of forms. As compared with the Asiatic, our representation of the family is more sombre-hued, owing to the absence of a number of

brilliantly colored *Choerocampinae* inhabiting the Himalayan region. The *Choerocampinae* are, also, the swiftest fliers and widest wanderers, with their pointed bodies and beautifully curved, sharply outlined wings. As Europe is visited by the celebrated Oleander Hawk and *Deilephila celerio*, which come from Africa, so we receive from the West Indies the visits of the Blue and Green Hawk, *Argus*, and the Wandering Bee Hawks, *Aellopos*, those "Mother Cary's Chickens" among the Moths. In North America the *Smerinthinae* are represented by several beautiful species belonging to the more typical, ocellated group; both *Calasymbolus* and *Paonias* are exceedingly richly colored and here the advantage is with the American, when compared with the foreign species belonging to this northern group. As a survivor of a former Arctic fauna, we have, in California, a *Smerinthus* related to the European *ocellatus*. But the less typical genera of the group, with unocellated secondaries, are feebly represented with us; of our two genera and species *Cressonia juglandis* is the only peculiar American form. In the *Sphinginae* the series of genera are more peculiarly American; the number of gray and blackish species recalling the *Noctuidae* in appearance is noticeable. In Europe, the numerous species of *Deilephila* are the remarkable features of the fauna; we have only two, both borrowed from thence, survivors of an extinct boreal representation of the family.

In the present work I mention the species inhabiting the Middle States, having in particular the State of New York under consideration, where most of my studies (either at Buffalo or the country about the City of New York) were conducted. As to the Florida Colony of tropical species, or the West Coast fauna of which I know but little, an account is given in other papers, the species being enumerated in my list above alluded to. My only synonym in this Family (and it might be well if my critics could show so clean a record) is *Lepisesia victoriae* from California, which is said to be Boisduval's *Pterogon Clarkiae*, a species I do not know. But my description was excusable since I was led to expect a species with angulated wings and resembling

Abbot's figure of *P. Gaurae* in Boisduval's insect, certainly not a *Lepisesia*, an insect resembling our Eastern *L. flavofasciata*. My type in Cambridge Museum must be examined and compared at the first opportunity. In the meantime I have here brought my work on this family to a final conclusion, having gone again over the literature and expressed my definite opinion as to the structure, generic categories, synonymy and nomenclature of the species discussed.

Classification.

Order **Lepidoptera.** Butterflies and Moths.

Scaly-winged Insects having the maxillae or mouth parts soldered together so as to form a tube, through which fluid food is sucked in by exhaustion; this spiral tongue is rolled up between the palpi. Wings four, in some females rudimentary; venation simple, consisting of two central veins and their branches, with a dorsal vein or veins belonging in reality to the median series; a median cell; no true cross-veins; the wings with fringes, wide and usually large in proportion to the body, furnished sometimes with folds and pouches: the scales laid shingle-like, overlapping: the presence of perfumed scales (Duftschuppen) has been discovered by Fritz Müller in certain males. Body divided into three parts, head, thorax and abdomen; tegument scaled or haired, rather soft; legs long and slender, often with tufts; the tibiae often spinose, clawed, furnished with a foliate epiphysis or swollen and shortened. Metamorphosis complete; pupa covered with an unyielding crust preventing all movement of appendages, with or without cocoon or silken attachments.

Series I. **Rhopalocera.** Day Butterflies, Butterflies.

This diurnal series need not detain us here and I would merely refer to my "Classification", in which I show the presence in North America of older types. Such an older type, synthetic as embracing characters of both series, is the *Paleohesperidae* m., a Family regarded by me as of equal value to the *Hesperidae* or *Papilionidae*. Under the name *Castnioides*, the type is shown by Prof. Riley to be a Butterfly; when I first examined it, the spinose legs led me to regard it as a Castniid after Walker. I believe to

have discovered a similar case in the Bombycid *Quadrina diazoma*. I described this Moth in Papilio 1, 175, comparing it with *Citheronia* and *Gloreria*. I only know the female; when the male and larva are known, my classification of the moth among my *Ceratocampinae*, will be tested. But the moth has pectinate antennae which seem to differ from this group. For this and other reasons, I believe we have to do with an external feeder, representing an ancient complex, having the characters of different groups of the lower Bombyces and, as I say, "structurally remote from any described United States genus." From such slender material I may be wrong to draw a decided conclusion, but I have long been of the opinion that we should find older existing types in North America than elsewhere and I mentioned this to my kind friend and excellent lepidopterist Mr. Arthur G. Butler, when I last had the pleasure of seeing him and studying the unrivalled collection of *Bombycidae* in the British Museum. For it is in the *Bombycidae* that we must expect just such discoveries in the Moths. We have certainly the oldest type of Butterfly now surviving in our *Paleohesperidae*. And this type tends to bridge the gap between the two series, so that we can feel more certain that the primitive type of the Order was a Moth, and that the Butterflies are a later development keeping pace with the flowers and the sunlight.

Series II. **Heterocera.** Night Butterflies, Moths.

I refer to my original paper (1873) on the differences between the Butterflies and Moths. This does not lie so much in the structure of the antennae as in their position. In the Butterflies they are more uniform in length and type, more rigid, directed upward; in the moths more varied, flexible, directed backward along the plane of the body, more susceptible to impressions. The eyes, although functionally incomplete and many-faceted, are probably of greater use to the Butterflies than to the Moths; in the daytime, no less than at night, the Moths depend more on the antennae, as may be seen by the quivering motion of these organs

before taking flight. I have seen these fundamental distinctions stated by no other author. The rigidity and uniformity of the antennae in the Butterflies point to a decrease of functional use.

Joined to such diverse antennae, the extremes of which I have given as represented by *Hepialus* and *Adela*, we have a great diversity in size and shape among the Moths as compared with the Butterflies. The tiniest Tineid is no larger than the diameter of the eye of the Great Gray Banded Owlet, *Thysania*, from the Brazils. The wings are various in color but especially in outline; they have clear spots, looking like holes, *Attacus*, *Apatelodes*, *Selenia*, or nearly scaleless, *Sesia*, *Hemaris*. In this latter the scales are present on leaving the pupa, and hence this may be a more recent form. The wings are entire but again are ragged and broken in appearance; in one group they are rayed. As the *Pyrалidae* and lower families have more than two dorsal or internal veins on secondaries, a section has been separated under the name of *Microlepidoptera*, as contrasting with all the rest, known as *Macrolepidoptera*. But the present classification into two Series by Boisduval and Duméril, seems to be both sufficient and natural. I have found some American *Pyrалidae* with only two internal veins, so far as I could see. The Moths farther contrast by their more woolly, tufted or hairy bodies, their nocturnal habit and a number of details adaptive to their mode of life. Most interesting are the American genera *Sphida* and *Arzama* among the Owlet Moths, the larvae of which, as discovered by my friend Prof. Comstock, are aquatic in their habit, recalling the previously known *Pyrалid* genus *Cataclysta* in this respect. The presence of a frenulum and hook on the wings further characterizes most moths. In the males the frenulum, arising from the costae of hind wings at base, is simple. In the following Family of Moths, the large size, and rapid flight has given them a position in the front rank. The first division into groups, as now adopted, will be found in my *Sphingidae* of Cuba, pp. 17—18 (1865).

Family Sphingidae.

Anglice: Hawk Moths.

Size moderate to very large; wings narrow, primaries long, secondaries short; frenulum present; fringes short; vestiture close; tuftings, except in the first tribe, wanting; abdomen long, heavy, the segments usually armed, tuberculate or spinose; head prominent; eyes large and naked, sometimes lashed; no ocelli; antennae prismatic; labial palpi stout; tongue very variable in length but usually long; flight sometimes diurnal, usually crepuscular, sometimes nocturnal.

We have originally proposed (1865) the European genera *Macroglossa*, with the type *stellatarum*, *Choerocampa*, with the type *porcellus*, *Smerinthus*, with the type *ocellata*, and Butler follows with *Acherontia*, with the type *atropos*, as typical of the five (5) groups into which the whole family may be divided. As far as we have seen, the extra-European genera may be arranged under these headings.

Subfamily Macroglossinae.

Anglice: Bee Hawk Moths.

Wings shorter than usual; abdomen wider and flatter with caudal tufts; flight often diurnal; pupation on the surface in a slight web of silk. Food plants, in preference, *Viburnum*, *Symphoricarpos*, *Lonicera*.

Hemaris. Dalman.

Head small, but not sunken, tongue as long as the body. Antennae clavate with terminal bent seta, biciliate in male,

simple in female; body smooth; wings largely vitreous, the clear spaces on emergence from the pupa thinly spread with glittering scales which fall on using the wings; body smoothly scaled.

Subgenus **Hemaris**.

The typical group is colored black and yellow with a red apical stain on forewings on the terminal black band. Type: *H. fuciformis*.

Tenuis. Grote. The smallest species with the wings full, without or with a hardly perceptible apical stain on terminal band which is narrow and *even* on its inner edge. Eastern and Middle States and Canada. June, July. *Larva* on *Viburnum*. I found the larva on *Symphoricarpos*, plentifully in the old Catholic burying ground at Buffalo, green with purple black venter and legs, with a rough yellow crest on first segment; it appears to differ by the absence of a dorsal shade from that of *diffinis*.

Diffinis. Boisd. A little stouter, the apical stain marked, the inner edge of the band finely dentate on interspaces. More southerly in its range. May to August. *Larva* on Bush Honeysuckle, Snowberry, Feverwort. (Fernald.)

Marginalis. Grote. Still larger, with the dentation prominent, as also the apical stain. Ohio, southwardly. I figure the differences between these species in the Buffalo Bulletin. The *larva* is not known.

Axillaris. G. a. R. The dentations are here unequal and very deep, the red apical stain extends downwardly over the nervules as an edging to the band. Ohio to Texas. The specific value of these forms has not been fully proven, nor the young stages compared.

Subgenus **Chamaesesia**. Gr.

Gracilis. G. a. R. Resembles somewhat the European *Bombyliiformis*, the band being of a brown tint. The forewings are bordered by brown above, beneath paler, with

white edging to the band within; hindwings crossed by *five* veins over the transparent disc, beneath with a yellow band at anal angle. June-July. Eastern and Middle States, Can. Rarer than the other species.

Subgenus **Haemorrhagia.** Gr.

The thorax is more produced in front than in the first groups and the body stouter, colors claret red and olive.

Thysbe. Fabr. (*Pelagus* Cram.). Forewings with the border claret brown or red, without apical stain; cell of primaries with a bar in middle; edge within of terminal band *dentate*. Can., southwardly. May to Aug. Larva on *Viburnum*. A dimorphic form, **Uniformis**, G. a. R., has the band *even*; the larva is described by Edwards and Eliot.

Buffaloensis. G. a. R. Smaller than the preceding; the cell has the bar fused with median vein; margin of terminal band *even*. Larva on *Viburnum* (Reinecke). June. New York. Considered by some writers not distinct from preceding, but the young stages have not been compared. Prof. Lintner describes the larva and considers the species distinct.

N. B. This genus is incorrectly called "Sesia" by some Authors, a name belonging to a different group as used by German writers and approved by Fernald. It is also merged with *Macroglossa*, the type of which is *stellatarum* and a number of Old World forms; against this practice I have protested from the very first of my studies.

Lepisesia. Grote.

Head somewhat sunken into the short and square thorax; the evenly margined wings are entirely scaled. Primaries with eleven veins, somewhat centrally depressed on costa. Legs comparatively long and slender; fore tibiae spinose. Flight diurnal. Larva unknown.

Flavofasciata. Barnst. Head and thorax pale yellow, palpi black, yellowish beneath; abdomen black, first segment

above yellow as also the terminal lateral tufts. Forewings blackish with a pale oblique band; hind wings with the disc bright orange yellow and black borders. Can., Eastern States, Northern New York. May—June. Very rare.

Amphion. Hubn.

Head small, but free from thorax, tongue nearly as long as body; antennae prominently hooked at tips. Forewings excavate below apex and above anal angle; hindwings with the margins slightly dentate. This genus approaches in some points the tropical genus *Perigonia*.

Nessus. Cram. Fore wings dull rusty brown crossed by a dark brown oblique band, beyond which is a line followed by shade spots of same color; hindwings dark brown with an oblique reddish central band, with pale yellow fringes broken with brown; beneath rusty red with pale yellow lateral stripe beneath the wings running from the antennae. Can. southward. Very common. May to Aug. *Larva*, green or brown, on *Ampelopsis* and grape and has a caudal horn wanting in the mature larva of the next genus.

Thyreus. Swains.

Head with a prominent ridged tuft above between the fusiform antennae which terminate in a long hook; thorax somewhat globular, stout, tufted behind; abdomen flattened, with anal tufts pointed in the female, more spreading in the male.

This genus is very distinct and somewhat isolated, while it sufficiently resembles the preceding. The abdomen in shape recalls the highest genera of the group.

Abbotii. Swains. Forewings very dark brown, angulated on outer margin, crossed by several darker dentate lines. Head wings lemon yellow with dark brown terminal band; beneath lighter colored. *Larva* greenish or brown, mature with an ocellus insted of the discarded anal horn, on *Ampelopsis* and grape. The moth is locally quite common. May to August. Canada southward.

Enyo. Hübn.

Head prominent with interantennal ridge, eyes large; thorax heavy; abdomen long and tapering with small terminal tuft; fore wings angulate.

Lugubris. Linn. Entirely dark brown, shaded with paler; the primaries with discal dot and exterior rigid line. *Larva* on *Ampelopsis* and Grape. May to September, double brooded in the South where it is common. New York to West Indies, rare in the North.

Deidamia. Clem.

Fore wings rather narrow as in *Thyrens*, and also angulated on external margin. Head with a ridged tuft between antennae which are fusiform and hooked at tips; abdomen with a slight anal tuft; tibiae unarmed. Allied to preceding genera by the tufts, the brown color and shape of primaries; the angulated genera of this tribe feed also on *Vitis*.

Inscripta. Harris. Greyish brown or reddish, the forewings crossed by three brownish bands. The outer margin has deeper colored lunules as in *Amphion*. Hindwings dull reddish brown with white fringes. *Larva* on *Ampelopsis* and grape, green with caudal horn. The moth is found from June to August. Canada to Virginia. Not common. No known *Smerinthoid* feeds on the grape.

Subfamily **Choerocampinae.**

Anglice: Elephant Hawk Moths.

Abdomen untufted; colors gay, often green, yellow and roseate, wings long and with sharp, often falcated tips, larva with the first segments narrow and capable of retraction; pupation sometimes in a slight cocoon on surface of ground; Food plants, in preference, *Vitis*, *Ampelopsis*.

Everyx. Boisd.

Head small with a ridged tuft between antennae which are slender, fusiform and hooked at tips, strongly biciliate in the males, simple in female. Fore and middle tibiae spinose; abdominal segments unarmed.

Choerilus. Cram. Rusty red and fawn color, wings crossed by various shade lines and with a discal spot, beneath paler. Common. May to August. Canada southwardly. Larva on *Ampelopsis* and grape, as also on Azaleas and Sheep-berry; Edwards and Eliot give *Viburnum*.

Ampelophaga. Bremer.

Agrees with *Everyx* except that the tibiae are unarmed. Larva transforming in a cocoon on surface of the ground.

Myron. Cram. Forewings grayish green with olive green bands; hind wings dull red. In the South occurs *var.* **Cnotus,** Hubn., with the primaries suffused and obscurely colored. May to August. Quite common. Larva on *Ampelopsis* and grape. Canada, southwardly.

Versicolor. Harris. A beautiful species with dark green forewings crossed by whitish lines and rust red hindwings with grayish and greenish borders; beneath, shaded with reddish, yellow and white. May to August. Canada to Middle States. Larva on *Cephalanthus*, and *Nesaea verticillata*. Rather rare. We are indebted to the researches of Rev. G. D. Hulst, for our knowledge of the larva.

Deillonche. Grote.

Head moderate, untufted; tongue as long the body; thorax smooth; abdomen slender, tapering; tibiae unarmed; eyes naked, unlashd; middle tibiae with one pair of unequal spurs, hind tibiae with two pairs; wings narrow; primaries 12-veined, evenly margined, outer margin somewhat sickle-shaped.

Tersa. Linn. Forewings light brownish yellow or ochrey, with a smoky brown spot at base and a number

of fine lines extending from apices to inner margin, diverging inferiorly; hindwings black with a subterminal row of wedge-shaped yellowish spots. Larva on Button weed (*Spermacoce glabra*). Rare in Canada and Eastern States, more common in the South; it has at least two congeners: **D. Robinsonii**, Grote, in Cuba and **D. Falco**, Walk., in Mexico; comparative studies must be made with other forms referred by Butler to *Choerocampa*, a genus with European types.

Deilephila. Ochs.

Head moderate, untufted; tongue about as long as the body; antennae enlarging to tips which are provided with a slender bristly hook; abdomen smooth, cylindrical, stout; tibiae unarmed; fore tarsi with a row of curved spines along the outside; wings entire, evenly margined.

Chamaenerii. Harris. Represents the European *Galii*, of which it seems a variety. The American specimens differ by a warmer tint on central fascia of forewings, which fascia is not excavated inwardly at base and not so continued superiorly, while our species has a distinct apical black streak; the hind wings more purely roseate. Not uncommon. Canada to Middle States. In Cuba **D. Calverleyi** takes its place. Larva on grape and Evening Primrose as well as *Epilobium*.

Lineata. Fabr. Differs from the European *Livornica* by a third, central white stripe on the tegulae and by the abdominal markings. Olive brown with a buff stripe on forewings from apex to base and the veins marked with white; hindwings black with a central reddish band enclosing a white spot near the margin. Very common, flying also in the middle of the day on flowers. Canada to West Indies and California. Larva on *Portulacca* and a large number of plants, very variable in color, caudal horn yellowish and rough. May to September; double brooded.

Philampelus. Harris.

Allied rather to *Deilephila*, though differently colored, the head being also more prominent, the tongue longer: the

abdomen tapers more gradually and in this resembles *Deilonche*; tibiae not spinose, middle tibiae with one pair of long, very unequal spurs, hind tibiae with two pair, all as in *Deilonche*, than which this is wider winged, heavier, differing by the cylindrical abdomen being armed on the hinder edge of the segments. In some respects the typical genus of the group; larvae on grape and *Ampelopsis*.

Vitis. Drury. (*Jussieuae* Hübn., *fasciatus* Sulz). A handsome species with bright olive green primaries, displaying a pale flesh colored stripe from apex to middle of the base and crossed by a similar one from middle of hinder margin to outer fourth of costa; hindwings rose red within, interrupted by whitish green hairs separating the rose red outer band, which is margined within by a black band; the rose colored terminal band is ended by a quadrate brown spot and distinguishes the present species. *Larva* on the grape. Rare in the North in June-July.

Linnei. G. a. R. This species, found only in the South, has been confounded with the foregoing by a number of writers and the synonymy became embroiled in consequence, until we figured and described it. Dark olive green, more robust than *Vitis*; the bands on anterior wings are mixed with white; the V-shaped space on internal margin large and not enclosed on margin. Hindwings green; a large rose-colored space on anal angle and along internal margin; a large black spot within; two narrow median lines; a broad subterminal black band; terminal space narrow, dull ochrey, nowhere pink and thus unlike *Vitis*. Both these forms are common in West Indies and South America where they feed on grape; the present is figured by Cramer under the name *Vitis*; but Drury, the Wiener Verzeichniss, Abbot & Smith and others sufficiently show what species is properly included under this title. Rare, in Southern States.

Posticatus. Grote. Only reported from Florida. Differs from *Satellitia* by its narrower shape and straighter external margin of the wings. Hindwings with a large roseate spot on internal margin covering anal angle; a

somewhat rounded blackish spot within; a subterminal series of interspaceal black maculations continued distinctly to costa. General color dull olivaceous. Described by me originally from Cuba under the name *Lycaon*, but differing from that species according to the British Museum collections. Food plant and larva unknown. Another West Indian species is described by me in the Bulletin of the Buffalo Society of Natural Sciences the type of which is contained in Agassiz*) Museum, Cambridge.

Pandorus. Hübn. (*Satellitita* Harris.) This species inhabits Canada and the Northern parts of the United States and differs specifically from the South American *P. satellitia* of Linnaeus. Pale greenish, marked with spots of rich olive green. The forewings have a large olive green spot on the middle of hind margin and a triangular spot of green rests on the hinder margin just within anal angle, while another, more diffuse, rests on costa a little within the apex; the wing is crossed by various shade lines and the veins are partly marked with ochrey, a character often escaping notice. Hind wings with a dark brown spot near hind margin and

*) During the life-time of this distinguished Naturalist and most successful lecturer and teacher, I was invited to study the *Sphingidae* in the Museum, but was unable to visit Cambridge at the time. The collection there contains but two or three of my types, sent me long afterwards for study to Buffalo. My letter from Prof. Louis Agassiz was as follows:

Cambridge, Dec. 11th. 1866.

Dear Sir!

In absence of Mr. Uhler, who may however return in a few days, I cannot say whether the collection of *Sphingidae* and moths are likely to be sufficiently extensive in your estimation to justify you in coming to Cambridge to work them up. Meanwhile I would say that if you decide to come I shall give you every facility I can for your work. I would be glad to see that part of our collections worked up. My son has already written to you what the rules of our Museum are; so I need add nothing upon this point. Mr. Uhler could give you more accurate information than I can concerning your arrangements here.

Very respectfully yours

(Signed) L. Agassiz.

a band of same color within outer margin which changes into lines and black spots towards the anal angle, there being no roseate patches or bands as in other species and as we see in the species of *Deilephila*. Common. May to August. Larva on grape, becoming brown at maturity, when the caudal horn of its first stages is discarded. Mr. Bunker of Rochester, N. Y., describes the larva and speaks of the number of broods.

Achemon. Drury. This species is pinkish gray with lovely rich brown patches, much as the deep green ones in *Pandorus*. Hind wings pinkish with a spotted, pinkish gray border. Larva on *Ampelopsis* and grape. Common and widely distributed. It is a curious fact that we have these two colors brown and green represented in the larvae and moths of so many species of Hawk Moths. This brown *Philampelus* has an ally in Mexico, and contrasts strongly with the numerous green species of the genus in color.

Subfamily Smerinthinae.

Anglice: Eyed Hawk Moths.

In this tribe the larvae have a cordate head and granulated appearance; the moths have the head usually improminent; tongue short and membranous; the body clumsy and the flight heavy and nocturnal; the typical genera have ocellated hindwings. The typical genus *Smerinthus* is confined to the West coast. Food plants, in preference, *Rosaceae*.

Calasymbolus. Grote.

Head small and sunken, more or less tufted between the antennae, in some species marked like a ridge; labial palpi short; segments of abdomen and tibiae unarmed. Forewings with the external margin even and more or less angulated not dentated.

a. Antennae of the male biciliated; tibiae unarmed.

Subgenus *Calasymbolus*. Gr.

Astylus. Drury. Our handsomest species, of a lovely rosy brown or cinnamon color, suffused with lilac; the tints recalling those prevalent in certain Saturnians or *Ennomidae*. Forewings but slightly angulated, with a purplish shade on internal margin and crossed by faint darker lines; a yellow spot at anal angle; hindwings ochre yellow, shading into rosy brown outwardly and a round black ocellus with a blue pupil rests on the wing near anal angle. Rare. June, July. Larva on Swamp Blueberry (*Vaccinium*). Canada to Middle States.

Myops. Abbot a. Sm. This species has the forewings more angulated and is a little slighter while of the same expanse. The wings are chocolate brown, darker and confusedly marked by lines and shades; hindwings yellow margined with brown and with a black, blue pupilled ocellus near anal angle. Larva on *Rosacea*, (Apple, Plum and Cherry). More frequent than *Astylus*. Canada to Southern States. Single brooded. June, July.

b. Fore tibiae with a terminal spine.

Subgenus *Copismerinthus*. Gr.

Cerisii. Kirby. This is a larger species than *Geminatus*, very rare and inhabiting Canada and the Northern States. The forewings are grey with wavy brown lines; hindwings dull rosy red in the middle and bordered all round with dull clay yellow and there is a black spot connected with the anal angle, on the hinder part of the red, containing a horse-shoe shaped spot of blue, the open part towards anal angle. In the next species this spot is *double*. May, June. Larva unknown.

c. Male antennae bipectinate; tibiae unarmed.

Subgenus *Eusmerinthus*. Gr.

Geminatus. Say. Gray, with a faint rosy tint, the forewings crossed by an angulated brown line followed by

a brown shade and this by several indistinct wavy lines; a lunule of brown edged with white at anal angle; hindwings rosy with gray borders and having a large black spot with two blue spots on it near anal angle. Occasionally a *third* blue spot appears on the black (*var. tripartitus*, Gr.) and sometimes but a single spot is found (*var. Jamaicensis*, Drury). *Larva* on *Rosaceae*, also on Willow. Not common. Single brooded, the moth appearing in June, July. Can. to Middle States. Drury's locality, if his indifferent figure represents our species, is incorrect. This species with others of this group brings forward the anterior margin of the hind wings in a state of rest. In this position the lovely *C. astylus* looks like a crumpled leaf.

Paonias. Hübn.

Head small and sunken with a prominent ridged tuft between the antennae; tongue membranous, no longer than palpi; antennae fusiform, biciliate in males, hooked at the end; thorax short; abdomen long, cylindrical, tapering, segments unarmed; tibiae unarmed; forewings regularly scalloped on terminal margin.

Excaecatus. Abb. a. Sm. Rich brown and fawn color, forewings crossed by sinuous brown lines; hindwings rosy red, with a black spot containing a blue center, bordered with fawn color, with a yellowish patch before anal angle. Common. June, July. Can. to Southern States. *Larva* on *Rosaceae*, Apple, Plum, Cherry etc., also on a variety of forest trees.

Cressonia. G. a. R.

Head small and sunken in thorax; form slender, that of the males recalling the American Bombycid genus *Apate-lodes*; palpi slim, divaricating at tip; abdomen slender, segments unarmed, with small anal tufts in male; all the tibiae armed with spinules; wings with the outer margins dentate.

Juglandis. Abb. a. Sm. Pale grayish fawn; forewings crossed by brown lines, the females paler colored; hindwings concolorous with wavy brown lines across the

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middle; unocellated. *Larva* on Walnut and Ironwood. Not common. June, July. Canada to Southern States. Varies in depth of color, sometimes with a light purplish reflection; distinguished by its slender form and bombyciform appearance; structurally it is nearest to *Paonias*.

Triptogon. Bremer.

Stout and sphingiform; head small and sunken; fore tibiae with a spine at extremity of the joint; tibiae else unarmed; surface of abdomen spinose beneath the scales; antennae fusiform without terminal hook, biciliate in males, simple in females. This genus prepares us for the following *Sphinginae*.

Modesta. Harris. This large moth is of a slaty gray with darker olivaceous bands and shadings on primaries; hindwings with a dusky roseate central patch. *Larva* on Poplar and Cotton wood. June to August. Canada to Southern States (*Cablei*) where the larva is said to feed on water plants. Not rare. A variety **Occidentalis** occurs in the West.

Subfamily *Sphinginae*.

Anglice: Typical Hawk Moths.

Large, usually gray and blackish species with well developed tongue and entire wings with internervular sub-terminal dashes on primaries. *Larva* pupating in the earth; flight crepuscular or nocturnal. Food plants, in preference, *Solenaceae*, *Syringa*.

Ceratomia. Harris.

The horned larva, feeding on elm, allies the moth to the preceding genus and the soft brown colors of the imago are *Smerinthoid*. Also the head is small, somewhat sunken as in preceding group. Abdomen heavy, tapering, the segments armed on

hinder edge; tibiae not spinose; antennae fusiform and ending in a small hook; forewings nearly entire, with a slight excavation at vein 2; all the characters show approximations to the *Smerinthinae* and warrant this arrangement of the family.

Amyntor. Hübn. (*Quadricornis* Harr.) Soft brown and whitish gray, approaching in its pale colors succeeding genera; forewings shaded with soft brown and crossed by gatherings of triple brown lines; hind wings clay color, shaded with brown; the fringes brown, cut with pale yellowish. *Larva* with the granulated appearance of preceding group. Common. Canada to Middle States. May to August, perhaps usually double brooded in southerly localities. In Buffalo, N. Y., larvae of the second brood failed to mature before the cold came.

Daremma. Walk.

Head small and sunken; antennae fusiform, with small hook; abdomen cylindrical and tapering, the segments armed as in *Ceratomia*, tibiae not spinose. *Larva* without horns on thoracic segments.

Undulosa. Walk. (*Reptentinus* Clem.). Gray, mixed with yellowish scales; forewings crossed by pairs of darker, wavy or angulated lines; hind wings darker, smoky brown, with the fringes white cut with brown. *Larva* on lilac, ash and privet. Not rare. Canada to Middle States. June August. In the South are allied species: **Hageni**, Grote, in Texas; **Catalpae**, Boisd., in Georgia and Florida. The tropical genus *Syzygia*, G. a. R., is related.

Diludia. G. a. R.

Larger and stouter, with the thorax more produced anteriorly; antennae fusiform, with slight terminal hooklet; abdomen cylindrical, the segments armed; wings entire, excavate above anal angle; rough gray species with darker secondaries. *Brontes* of Drury, recognised by me from Cuba, belongs here.

Jasminearum. Boisd. a. Lec. Size large, gray: the forewings crossed by wavy lines, and with darker, brown shadings, and smoky brown, shaded secondaries. Rarely found in Middle States; Long Island (Hulst); not common in the South and one of the rarer species of the family.

Dolba. Walk.

A smaller form than those with which it is here associated, yet agreeing in some respects with *Daremma* and standing between it and *Phlegethontius*; the head is small, though free, and roughly scaled; the tongue longer than the body. The abdomen is somewhat conical and peculiar in shape; the segments armed with round spinules; the tibiae unarmed; the thorax approaches by its shape that of *Phlegethontius*, and in colors the single species has a slight resemblance to *P. rustica*.

Hylaeus. Drury. (*Prini* Abb. a. Sm.) Dark rusty brown; thorax white on the sides; abdomen with a row of lateral white spots; beneath white; forewings dark rusty brown, with a white spot at base and one on disk, crossed by dark brown lines and with an apical white shading; hindwings dark smoky brown crossed by two dentate white lines; fringes checkered, white and brown. *Larva* on *Ilex*, Papaw (*Asiminia triloba*), perhaps (Scudder) on Sweet Fern. Not rare in certain localities. Canada to Gulf States, rather more usual in the South. June, July.

Phlegethontius. Hübn.

Large species of an iron gray color with large, brightly colored spots on the side of the abdomen, yellow or rose color; the species are Southern except *P. celeus*; it is probable that the European *convoluti* belongs here and not to the genus *Sphinx*. Thorax with part colored metathoracic tufts. The tongue exceeds the body; the head is prominent, large; eyes salient; antennae fusiform ending in a slight seta; abdomen with the segments armed with round spinules; tibiae unarmed; wings ample, entire. *Larva* with a thick caudal horn, pupating in the ground; *pupa* with the tongue

case separate, "like a jug-handle." There is a certain resemblance between this and the next genus to the *Acherontinae*, an Old World group, and this in all stages.

Rustica. Fabr. (*Chionanthi* Abb. a. Sm.). Very large, the primaries shaded with deep brown; abdomen with yellow spots; a handsome species, found only occasionally outside of the Southern States; reported to me from Ohio and Kentucky, also New Jersey.

Carolina. Linn. "Tobacco worm." Dark gray, the wings crossed by a number of wavy, indistinct lines; a white spot at base of forewings and one edged with dark scales on disc; hindwings gray, with a basal smoky spot, crossed by three darker lines and with smoky borders; abdomen with five dark yellow spots, surrounded with black. *Larva* on *Solenaceae* (Tobacco, etc.). Common; double brooded. West Indies, northward to Canada.

Celeus. Hübn. (*Carolina* Harr.). "Tomato worm." This is rather heavier than preceding and more common at the North, I have not seen it from the Gulf States. It is paler colored, more cinereous or ashen; forewings with the lines more evident; hind wings quite pale crossed by two strongly dentated lines over the middle, a curved line within and a smoky spot at base of wing; abdomen with five dark yellow spots as in preceding species (hence the name *5-maculata*, under which this form was described by English authors). Common, double brooded. *Larva* green and brown in color, on *Solenaceae*, especially Tomatos, also on *Datura* and Tobacco. Canada southward.

Cingulata. Fabr. Much stouter than the European *Convolvuli* and shaded with brighter roseate. Very dark gray; the thorax behind distinctly shaded with blue and yellow over the metathoracic tufts. Hind wings shaded with rose color and five rose colored spots, somewhat squarer than usual, adorn the abdomen, separated by black bands. Not so common as the preceding. West Indies, northward to Canada. *Larva* on *Convolvulus*, Sweet Potato and also on *Solenaceae*.

Atreus. Grote.

Smaller and approaching *Sphinx* in appearance; the head prominent; eyes salient; antennae slender at tip where they are bent; fore tibiae spinose as (according to Fernald) are those of *P. celeus*. The type is, I think, not congeneric with the European *Pinastri*, nor can I find an Hübnerian genus for its reception; I should leave it in *Phlegethontius*, as Fernald seems to suggest, but it differs in the 12-veined primaries, the want of an antennal seta, in the fusion of the tongue-case in the pupa and in the general style of markings no less than in the structure of the labial palpi. *Sequoiac*, Boisd., may belong to *Hyloicus* and be congeneric with the European *Pinastri*, which this is not.*)

Plebeius. Fabr. Forewings gray, with a white discal spot ringed with black, heavy black dashes between the veins and crossed by faint, partly incomplete lines. Hindwings dark smoky brown, grayish towards base and on the anal angle; fringes brown and white. Larva somewhat rough with a caudal horn curving only towards its tip, blue, with irregular black tubercles; the caudal horn will be found to play an important part in the classification, as it varies so much in length and appearance. It rises from the top of the hind segment and is a prolongation of the skin itself, stiffened by chitine. It is sometimes discarded, replaced by an eye-spot. It is very curious in this species and there is a slight approach to *Acherontia*. *Atreus plebeius*, feeds on Trumpet Creeper (Fernald) and *Syringa*, where I have found it. The moth approaches the section of *Sphinx* called by Butler *Lintneria*, but differs much more strongly in structure. We have, then, in Eastern North America no equivalent to the European *Hyloicus pinastri*. A second species of *Atreus* probably occurs in Cuba, described by myself, but I have now no types to compare.

*) I have used for study larvae of the European *Pinastri*, beautifully prepared according to the method explained by Karl Wingelmüller in his interesting book: Der Käfer- und Schmetterlings-Sammler, Magdeburg, Creutz'sche Verlagshandlung.

Ellema. Clemens.

Head small and somewhat depressed, but not sunken as in *Smerinthus*, which this genus approaches in its Bombyci-form look; the wings however are entire, Sphingiform; the tongue is short and membranous, but it differs in the young stages by having no caudal horn and the head not being heart-shaped; according to Fernald "the young larva has a round head (of *coniferarum*) but it changes at the first moult to an angular form running up to a sharp point at top." In ornamentation this genus differs by the immaculate abdomen, also a *Smerinthoid* character, but the pattern of primaries is like the ensuing *Sphinginae*, having longitudinal streaks on the interspaces. We may say that the wings are those of a *Sphinx* the body of a *Smerinthus*. A letter from Dr. Clemens, dated in 1865, and explaining his reasons for describing this genus, is before me as I now write. From the first, I have kept *Ellema*, as a genus, distinct. From the habit of the larva and its feeding on Pines, it has always been approached to *Hyloicus*, but the immaculate abdomen at once excludes it, no less than the short maxillae. It is now referred to the *Smerinthinae* by Fernald, but the larva does not seem to me to be that of a *Smerinthoid* form. I regret not to have material now before me and I am writing from old notes on the species, which I have seen, all but *bombycoides* (this from a figure). It struck me that they were very near and possibly only variations of a single form, the *coniferarum* of Abbot a. Smith. Prof. Fernald, apparently on Mr. Thaxter's authority (a most excellent one), considers *bombycoides* and *Harrisii* as forms of one species. Prof. Fernald further distinguishes *coniferarum*, while he does not allude to *pinum* of Lintner, a New York species, but, if valid, certainly not confined to New York, which State belongs to southern New England so far as the Lepidopterous fauna is concerned, its northeastern portion, in its fauna, to Eastern Canada. This genus is evidently of wide distribution and distinctively North American. For the present I leave further discussion of the species. The genus itself might inaugurate the present group if my arrangement of

the family is retained, but I prefer to regard it (with *Eredrium*) as more related to *Sphinx* proper; in any event it marks the approach of the two groups *Sphinginae* and *Smerinthinae* and thus favors my idea that the latter group has given rise to the former as well as to the *Choerocampinae*. Without material at hand for dissection, I am not willing, from what I know now, to accept my friend's view that *Ellema* is a *Smerinthoid* genus. The central position I give the *Smerinthinae*, expresses my idea that the other groups may have arisen from its ancestors; while at present its members are on the whole perhaps nearer the *Choerocampinae* than the *Sphinginae*.

Sphinx. Linn.

The type of this genus is originally held by me to be the European *S. ligustri*, and hence the genus is synonymous with *Lethia* of Hübner. The head is prominent; tongue about as long as the body; palpi moderate; general form slighter than in *Phlegethontius*. Abdomen tapering to a point, banded and marked with white, less prominently marked than in *Phlegethontius*; *Larvae* smooth, with ovate head, caudal horn usually straight and pointed; *pupa* in the ground, flight generally crepuscular. This genus contains perhaps the typical species of the family, but not the highest in structure and habit. The more compact shape, diurnal flight, and surface pupation of *Macroglossinae* and *Choerocampinae* seem to accord them this position. The European *S. ligustri* has a suffused roseate tint reminding one of the rosy species of *Phlegethontius*; none of our species have this, but *luscitiosa* in one sex at least, has a decided yellowish tinge. The value of the genus encreases in North America, the species being comparatively numerous and the West producing forms of small size but great beauty, as the well known *S. Elsa* of Strecker. The interspaceal black dashes on primaries constitute the typical ornamentation of this subfamily.

Drupiferarum. Abb. a. Sm. Head and thorax brownish black with a light gray stripe along the side meeting in front over the tips of the palpi; forewings dark

brown, with the costa striped with light gray and the outer border of same shade, crossed by oblique blackish wavy lines, while there is a series of interspaceal subterminal black dashes, the discal spot itself being a fine black line; the hindwings are dark brown, whitish at base, having also a narrow whitish median stripe and pale border; fringes brownish. A common species. Canada southwardly. *Larva* on Plum, Apple and several smaller shrubs such as Privet and Lilac, May, August.

Kalmiae. Abb. a. Sm. Much shaded with bright brown and differing in color from the other species; thorax chestnut brown with yellowish side stripe; forewings pale yellowish brown shaded and marked with chestnut brown as in the other species; fringes checkered rusty brown and whitish. Less common than preceding. *Larva*, besides *Kalmia*, feeds on Ash and several sorts of shrubs. Canada southwardly. May, August. These two agree in form and size most nearly with the European type of the genus *S. ligustri*.

Chersis. Hübn. (*Cinerea* Harr.). Ash gray, a little larger than the other species, with the interspaceal dashes on primaries contrasting; hindwings pale gray with brownish median and terminal bands. *Larva* on Ash and various shrubs. Not common. Canada southwardly. This species has a more Northern range. June, July.

Canadensis. Boisd. (*Plota* Streck.). Smaller than the preceding, of a light brownish gray, forewings crossed by several incomplete oblique lines, and with distinct interspaceal dashes, a subterminal black line edged with whitish extends nearly to the apex, followed by another within; hindwings pale gray with a spot at base and a central and subterminal brownish band. Still more Northern than *Chersis* (to which it is somewhat closely allied) in its range. *Larva* according to Thaxter, probably on *Rubus*, and *Vaccinium*. Not common. Canada, Newfoundland, Maine. June, July.

Luscitiosa. Clem. This rare species is gray with the hind wings and abdomen suffused with yellowish in the

males (this brighter tint appearing somewhat as the roseate in *ligustri*); head above and thorax black; forewings pale brown with the margins dull blackish; veins marked with black; the white discal dot has a line attached, double at first; fringes black; hindwings gray with a broad terminal black border and faint median band; fringes pale; beneath also yellowish in male, gray in the opposite sex. *Larva* on Willow (Hulst). Canada to Middle States. This is probably our rarest Hawk Moth of these kinds, proper to the Middle States. Related in markings to succeeding species. The yellow suffusion of the male is most curious.

Gordius. Cram. Gray; forewings clouded with dull brownish or blackish; discal spot small, white and triangular, two fine lines emerging from it crossing the cell and uniting; veins more or less marked with black; a regular series of interspaceal dashes, the upper forming apical streak; fringes whitish, cut with brown; hindwings whitish with blackish borders and central band; fringes white. *Larva* on Apple, Ash, etc. Quite common. Canada southwardly. Related to *Luscitiosa*, but a little stouter. So far the species here cited are related in pairs; the smaller forms of *Sphinx* are (see my paper in Silliman's Journal) an American expansion of the genus.

Eremitus. Hübn. Forewings brownish gray, with a white discal spot set in a black dash, crossed by blackish shade bands in pairs and with the interspaceal dashes marked; hind wings white with a black basal spot and a median and broad terminal band. *Larva* on Spearmint and *Salvia*. Canada, southwardly. Not common. I do not find any grounds for separating this generically and have referred it to this genus in my Lists; **Lugens** Walk., from the West is an allied species.

Dilophonota. Burm.

The form is that of *Sphinx* (*Lethia* of Hübner) but is slenderer yet, the wings sharp at tips, abdomen longer, more gradually pointed. The thorax is bicrested, rounded in front, not so square as in the allied genus *Isochnathus* of Felder.

From the colors and banded abdomen, I follow these insects with the final subfamily *Acherontinae*, not found in North America.

Ello. Linn. "The Wandering Hawk." Light gray, the female darker, hind wings russet, abdomen banded with black. Breeds in the extreme South, West Indies and Mexico. A wanderer in the North, which it reaches in the Fall.

Remarks.

As I have elsewhere pointed out the Macroglossians with angulated wings form a subgroup, leading to the Choerocampians. The typical subfamily contains *Hemaris*, *Aellopos*, *Lepisesia*, *Macroglossa* and allies, with even wings. My classification is based on natural characters, and no scientific reasons have been brought forward by any dissident. It has been said that a certain class of minds differ mainly to differ and, in the arrangement of such delicate animals, the range of untrained opinion has been found to be wide.

Considering, as I do, that the *Sphingidae* may have been evolved from the ancestors of the *Ceratocampinae*, I regard the subterraneous pupation, without silk, as a low or derivative character, together with the crepuscular or nocturnal flight. On the other hand the surface pupation, the use of silken threads, the diurnal flight, as an approach to the *Hesperidae*. The surface pupation of tropical *Sphinginae* must be studied in connection with terrestrial conditions. There is a slight resemblance in the larvae between the *Papilioninae* and *Choerocampinae*.

The generally smooth larvae show exceptionally thoracic crests, as in *Triptogon* and *Ceratomia*, genera accordingly related; and this would be a retained character, recalling *Eacles imperialis*. The rough, shagreened skin of the Eyed Hawks is also probably a modified survival. The proofs that the passage to the *Sphingidae* has been through what we now regard as older forms of Bombyces, are thus many and, if we place this family at the head of the Moths, it is not that it has real affinities with *Castnia*, which has probably a different immediate origin.

The *Sphingidae* have their metropolis in the tropics, not suited in their habits to the cold of high latitudes; the Eastern portion of our continent is subject to the advent of occasional visitors coming on the summer winds from the West Indies and Florida. Among these occasional visitors may be cited *Aellopos titan* and *taniclus*, *Argus labruscae*, *Dilophonota ello*. It is not known how far South our Northern species of *Smerinthinae*, *Sphinx*, etc., range, but I found none of them in Cuban collections and it is probable that they do not even reach the Gulf. With regard to classification, the present is considered now generally by Authors a distinct family. It seems to have been regarded formerly as a sub-family of "*Sphinginae*", equivalent in value to the *Sesiidae* or "Clear wings."

Our Hawk Moths are in part (1) descended from a Tertiary Arctic fauna, in part (2) of South American origin, while (3) several forms must be considered as strictly North American and as the direct survivors of the tertiary fauna of the Continent. On these points various papers in "*Papilio*", "*Silliman's Journal*", etc., may be consulted. Genera belonging to the *first* category are marked, in the following list, with (E), to the *second* (S), to the *third* (N). These categories are provisional and demand further studies in this direction, and are here not fully carried out, for want of data. The food plants of the *larvae* are deciduous plants, shrubs and trees, except *Ellema* which feeds on pines (*Coniferae*). I have found *Sphinx kalmiae* on plants of Mountain Laurel (*Kalmia*) not a foot in height, the larva being much exposed. The larvae suffer greatly from the attacks of *Ichneumonidae*: this alone prevents certain kinds of *Philampelus* and *Phlegthontius* from becoming very injurious. In the South the *Catalpa* trees are defoliated by *Daremma Catalpae*, but, strange to say, the pupae seldom give the moth. The pupation of this group is more dangerous to the individual than in the cocoon-making groups; interference with the larva seeking pupation seems readily fatal; often the ground is not suitable and the roving larva falls a prey; these heavy, naked larvae fall also victims to storms, by which they are shaken

from the trees to certain death; their tenacious grasp I have then noticed to be insufficient, although the strength of their anal claspers is very great. The following list may be of service in arranging collections, from Canada as far south as the Middle States, the species from Texas, Florida, and the Southern States, as well as the Californian forms, may readily be interpolated; these are all given, to the total number of 95, in my lists and catalogues. I am disposed to regard nomenclature and classification absolutely correct, as far as my long experience and study can make them so.

Species and genera here discussed.

Macroglossinae.

Hemaris. Dalm. (E)

tenuis. Grote.

diffinis. Boisd.

marginalis. Grote.

axillaris. G. a. R.

gracilis. G. a. R.

thysbe. Fab.

buffaloensis. G. a. R.

Lepisesia. Grote. (N)

flavofasciata. Barnst.

Amphion. Hubn. (N)

nessus. Cram.

Thyreus. Swains. (N)

abbotii. Swains.

Enyo. Hübn. (S)

lugubris. Linn.

Deidamia. Clem. (N)

inscripta. Harris.

Choerocampinae.

Everyx. Boisd.

choerilus. Cram.

Ampelophaga. Brem.

myron. Cram.

versicolor. Harris.

Deilonche. Grote. (S)

tersa. Linn.

Dellephila. Ochs. (E)

chamaenerii. Harris.

lineata. Fab.

Philampelus. Harris.

vitis. Drury.

linnei. G. a. R.

posticatus. Grote.

pandorus. Hübn.

achemon. Drury.

Smerinthinae.**Calasymbolus.** Gr. (E)

- astylus.* Drury.
myops. Abb. a. Sm.
cerisii. Kirby.
geminatus. Say.

Paonias. Hübn. (N)

- excaecatus.* Abb. a. Sm.

Cressonia. G. a. R. (N)

- juglandis.* Abb. a. Sm.

Triptogon. Brem. (E)

- modesta.* Harris.

Sphinginae.**Ceratomia.** Harris. (N)

- amyntor.* Hübn.

Daremma. Walk. (N)

- undulosa.* Walk.

Diludia. G. a. R.

- jasminearum.* B. a. Lec.

Dolba. Walk. (N)

- hylaesus.* Drury.

Phlegethontius. Hübn.

- rustica.* Fabr.
carolina. Linn.
celeus. Hübn.
cingulata. Fabr.

Atreus. Grote.

- plebeius.* Fabr.

Ellema. Clem. (N)

- coniferarum.* Abb. a. Sm.

Sphinx. Linn. (E)

- drupiferarum.* Abb. a. Sm.
kalmiae. Abb. a. Sm.
chersis. Hübn.
canadensis. Boisd.
luscitiosa. Clem.
gordius. Cram.
eremitus. Hübn.

Dilophonota. Burm. (S)

- Ello.* Linn.

List of Plant genera,
the different members of which are eaten by the larvae of
Sphingidae. The best time to find these, nearly or quite
full grown, is July to September.

- | | |
|--|--|
| 1. <i>Amelanchier</i> . Shadbush. | 26. <i>Ostrya</i> . Iron 1 |
| 2. <i>Ampelopsis</i> . Virg. Creeper. | 27. <i>Physalis</i> . Ground Cherry. |
| 3. <i>Asimina</i> . Pawpaw. | 28. <i>Pinus</i> . Pine. |
| 4. <i>Azalea</i> . Azalea. | 29. <i>Populus</i> . Poplar. |
| 5. <i>Betula</i> . Birch. | 30. <i>Portulaca</i> . Purslane. |
| 6. <i>Carya</i> . Hickory. | 31. <i>Prunus</i> . Plum, Cherry. |
| 7. <i>Cephalanthus</i> . Buttonbush. | 32. <i>Pyrus</i> . Apple. |
| 8. <i>Comptonia</i> . Sweet Fern. | 33. <i>Quercus</i> . Oak. |
| 9. <i>Crataegus</i> . Hawthorn. | 34. <i>Rosa</i> . Wild Rose. |
| 10. <i>Datura</i> . Jamestown weed. | 35. <i>Rubus</i> . Blackberry. |
| 11. <i>Diervilla</i> . Bush Honeysuckle. | 36. <i>Rumex</i> . Dock. |
| 12. <i>Epilobium</i> . Willow herb. | 37. <i>Salix</i> . Willow. |
| 13. <i>Ilex</i> . Inkberry. | 38. <i>Salvia</i> . Lir ver. |
| 14. <i>Juglans</i> . Walnut. | 39. <i>Spermacoce</i> . tonweed. |
| 15. <i>Kalmia</i> . Mountain Laurel. | 40. <i>Spiraea</i> . Spiraea. |
| 16. <i>Ligustrum</i> . Privet. | 41. <i>Stellaria</i> . Chickweed. |
| 17. <i>Liquidambar</i> . Gum tree. | 42. <i>Symphoricarpus</i> . Snowberry. |
| 18. <i>Liriodendron</i> . Tulip tree. | 43. <i>Syringa</i> . Lilac. |
| 19. <i>Lycium</i> . Matrimony vine. | 44. <i>Tecoma</i> . Trumpet Creeper. |
| 20. <i>Mentha</i> . Spearmint. | 45. <i>Tilia</i> . Basswood. |
| 21. <i>Monarda</i> . Bergamot. | 46. <i>Triostemum</i> . Feverwort. |
| 22. <i>Myrica</i> . Sweet gale. | 47. <i>Ulmus</i> . Elm. |
| 23. <i>Nesaea</i> . Loosestrife. | 48. <i>Vaccinium</i> . Blueberry. |
| 24. <i>Nyssa</i> . Sour Gum. | 49. <i>Viburnum</i> . Snowball. |
| 25. <i>Oenothera</i> . Even'g. Primrose | 50. <i>Vitis</i> . Grape. |

Tropical species

forming part of the colony in southern Florida:

Cautethia *grotei*.

Enyo *camertus*.
danum. —

Philampelus *posticatus*. —

Pachylia *figus*.
syces.

Ambulyx *strigilis*. —

Diludia *brontes*. —

Amphonyx *antacus*.
duponchel. —

Of the names followed by a dash (—) I have seen no specimens from Florida; the sign is also used after species unknown to me.

Species peculiar

to the fauna of the Southern States, not tropical so far as known:

Hemaris *fuscicaudis*.
floridensis.

Lepisesia *circae*. —

Pogocolon *gaurae*. —

Pachylia *lyncea*. —

Daremma *hagenii*.
catalpae.

Diludia *jasminearum*.
leucophaeata. —

Exedrium *halicarnie*. —

Dilophonota *fasta*. —
obscura.
edwardsii. —

Species found in the tropics,

breeding also in the Southern States and occasionally appearing
in the North, irregularly or as wind visitors:

Aellopos *titan*.
tantalus.

Enyo *lugubris*.

Philampelus *vitis*.
linnei.

Argeus *labruscae*.

Phlegethontius *rustica*.

Dilophonota *ello*.
melancholica.
merianae.

Species peculiar to California
so far as known to me.

Hemaris *palpalis*.
thetis.

Euproserpinus *phaeton*.

Arctonotus *lucidus*.

Lepisesia *clarkiae*. —

Smerinthus *ophthalmicus*.

Hyloicus *sequoiae*. —

Sphinx *perelegans*.

These concluding geographical lists will at least give a general idea of the distribution of certain forms of North American Hawk Moths.

The *Sphingidae* are probably not represented in Labrador. In Newfoundland *S. canadensis* occurs; the species of the highest range to the north are probably *Hemaris uniformis*, *Deilephila chamaenerii* and *lineata*, *Smerinthus cerisii*, *Ellema bombycoides*, together with this species of *Sphinx*. No Hawk Moths fly in Iceland; the family ceases to exist, probably before any other of the larger families of Moths, on the way to the Pole. In Upper Canada most of the species of the Middle States may be found. It is in the tropics, under a warm sun and surrounded by a various flora, that the Hawk Moths reach their highest development in kinds and numbers. Our largest species is *Amphonyx antaeus*, the smallest, *Euproserpinus phaeton*. Our finest northern form (with a wide range) is *Triptogon modesta*, somewhat inappositely named, but varying greatly in size and depth of color.

Besides the special Authors cited, we are indebted to Prof. C. V. Riley for some exquisite drawings of larvae, to Prof. Saunders and Roland Thaxter for descriptions of larvae, while Mr. W^m. Beutenmüller jr., has largely added to our knowledge of their food plants. The Rev. Mr. Hulst, Prof. Lintner, Mr. S. Lowell Elliot and Mr. S. H. Scudder have also made valuable observations on their transformations and immature stages, while Prof. Alex. Agassiz and Dr. Wittfeld have encreased our information as to the species inhabiting the Florida Peninsula.

L'Envoi.

Ich mag in diesem Hexenheer
 Mich ganz und gar verlieren.

Goethe.

Pantheism is directly fostered in the mind of man through the study of Entomology. It appeals to him by the display of that which is beautiful in Nature and it may be said that the worship or cult of Butterflies has taken root among us. As such it opposes the view of Deism, as an intellectual solution of the world-all. My old friend Sanborn was taken to task, upon religious grounds, for collecting on Sunday. He replied to his interlocutor, a New England clergyman, that "if God would shut up his Butterflies on Sunday, he himself would not go out after them." To Sanborn, Butterflies were a part of the Divinity in nature. He was a Pantheist and met the demands of the orthodox Deists by the creed that the woods are God's temple in which man seeks the Divinity in the rays of sunlight glinting across the green leaves, in bird and beast and butterfly and flower. The search was to him always religious and hence justifiable. This argument is more or less consciously advanced by all Entomologists, who, as a body, classify their collections rather than their thoughts, perhaps. They worship none the less fervently at the Altar of the Hours than the believers at that of the Sacraments. I have elsewhere dwelt on this subject of the latent Pantheism in our race. While the Semite accepts all indistinguishably from the hand of the Creator, the Indo-German examines and arranges. The observing Greek Poet claps the wings of the Butterfly on the immortal and beautiful shoulders of Psyche and wings his figures of Love and Death like Birds. The cult of Butterflies is too strong for some of us. It causes Mr. Strecker

to advertise that he "covets" specimens and even to consider the loss of life on a Polar Expedition justified in the capture of some rare species. When Mr. Strecker or Mr. Neumoegen talk in print about „Science“, one hears them with a certain shock, feeling that this is not always the correct term to be applied to a propensity for collecting and naming Butterflies.

A more intimate relationship between the *Sphingidae* and *Bombycidae* is suggested by the American group of the *Ceratocampinae*. Already in 1865 I call attention to this, but I regard it then as a matter of Analogy rather than Affinity. If we regard the larvae of the *Ceratocampians*, which I have studied and described in part, we see a loss of the spines and diminution in length through the series *Citheronia*, *Anisota*, *Dryocampa*. These three genera are the nearer related, the other series is *Eacles*, *Sphingicampa*. The larva of *D. rubicunda* has lost all but the fore and aft dorsal spines; the *Sphingidae* have become smooth and only have a ridge behind the head or the anal spine represented by a fleshy horn. I do not know the larva of *Quadrina*, which I placed temporarily at the head of the *Ceratocampinae*. It is perhaps the remains of another old type of Bombyces. In America we shall have probably to do with remains of older types than elsewhere on the globe. This I have already pointed out, regarding the *Ceratocampinae* as remains of an old type and nearer to the Hawk Moths than any subfamily of the Spinners now existing. This subfamily has short antennae and a long and heavy body, a pupation like the *Notodontinae* and *Sphingidae*, very bright colors quite different from the *Cossinae*, but some *Hepialinae*, which I separate from Dr. Packard's *Hepiali*, are also very gaily marked. These old types are very interesting and we may briefly allude here to the *Paleohesperidae*, which seem to stand between the Butterflies and Moths.

The genera of the *Ceratocampinae*, leaving *Quadrina* for the moment out of the question, should be arranged thus: 1st. *Eacles*, *Adelocephala*, *Sphingicampa*; 2ndly. *Citheronia*, *Anisota*, *Dryocampa*. The male and the caterpillar of

Quadrina diazoma Grote, must both be known before it can be placed with certainty. According to my friend Mr. Robert Bunker, *Citheronia regalis* comes occasionally to bait after the fashion of a *Sphinx*. The resemblance between the American genera *Eacles* and *Ceratomia* is pointed out by me in 1865. I bring *Triptogon* and *Ceratomia* together from the thoracic "horns" of the larvae, resembling each other and this Bombycid genus. I have thus two points to excuse my arrangement of the *Smerinthinae*, viz: the resemblance between *Ambulyx* and *Calasymbolus* at one end and *Triptogon* and *Ceratomia* at the other. It is the young stages which must afford us a guide in our deductions and, already in 1865, I have seen the importance of evidence which leads me to insist upon my classification of the *Sphingidae* today and the longer they are studied. As to the importance of studying American forms there can be no question if, as I believe, older types exist here than elsewhere. Just as I believe the species of *Basilarchia* to be recently separated, I look upon the *Paleohesperidae* as relics of a very old and else obsolete type of the Lepidoptera. In the question of the relationship of the *Sphingidae* and the *Bombyces*, the "horn" of *Bombyx mori* must be remembered, no less than the distention of the anterior segments of this larva which recalls the Elephant Hawk Moths. While I think there can be no doubt that the membranous tongue in the *Smerinthinae* is a retained character, the question is not so clear with *Ellema*, in which the character may be one of reversion.

The characters of the Family *Paleohesperidae* (consult my paper, Can. Ent. 173, for the year 1875, where they are first announced) are as follows: Eyes large and naked. No ocelli; caputal squamation mixed flattened scales and hair. Antennae capitate, without terminal inflection. Wings heavy, entire. Tibiae and tarsi strongly spinose; hind and middle tibiae with terminal claws. Legs stout. The three parts of the body unusually distinct. Form cylindrical. Head broad in front. Ornamentation much like the *Hesperidae*, brown and yellow. The characters by which this Family is separated from the other Butterflies, are taken from the

Castniadae. Besides *Yuccae*, Felder describes and figures a Mexican species in the Wiener Ent. Monatsschrift. In the long abdomen, the segments distinct, and head parts, are resemblances to the Moths.

In my earliest papers (1865) on the Hawk Moths, I have spoken of the dimorphism of the caterpillars, *Deilephila*, *Phlegethontius*, and then of the ampelophagic genera, showing that they possessed indifferently, without regard to sex, a green or brown tint. I called these tints "cosmical", the brown being like that of the earth and the green like the vegetation. In this view they are protective. Several green larvae in the Hawk Moths become brownish during the last twenty four hours, while wandering over the soil before pupation. This change in color takes place even in confinement over a white surface. The origin of this dimorphism offers an inviting study; it occurs in many Moths and some Butterflies. In my writings I have maintained the following theses. That the lepidopterous fauna of the summit of the White Mountains (*Oeneis*, *Laria*, *Pachnobia* etc.) is a relic of the Glacial Epoch. That our fauna has three proximate sources, boreal (E), austral (S) and indigenous during tertiary times (N). That certain forms such as *Scoliopteryx* and *Dipterygia* have remained unaltered since the separation of the European and American faunae by the Ice Period, while others, as *Catocala relictæ*, *Copimamestra occidentalis*, have become distinct species. Intermediate are those species which differ only in one stage, and that mostly the larval, such as *Apatela occidentalis* from *A. psi*. I have shown the method of variation, in its expression in the perfect insects; the retention, occasionally, in specimens of *relictæ* of blue scales on the band proves the reversion to the European *fraxini*. I have further shown that, in genera of Southern extraction, the area of successful hibernation is more restricted than that of the summer flight and breeding of the Moth, as in *Aletia argillacea*, the Cotton worm.

My theory (Detroit Meeting, Am. Ass. Aug., 1875) that the Butterfly fauna of the summit of Mount Washington is a survival from the Glacial Epoch, equally with the theory

of the tropical origin of the Cotton worm, was reached by me through independent studies. The latter was in contradiction to that point of view from which the Cotton worm was treated in the "Missouri Reports" by Prof. C. V. Riley. A subsequent attempt to deprive me of originality on the discovery of the "Boston letter", not only fails when the letter itself is compared with my observations, but is without force as coming from Prof. Riley, who was equally unaware of the existence of the letter with myself at the time of reading my paper.

I have also shown the existence of generic groups of forms more closely related than is usually the case, such as *Datana*, *Nadata*, the European *Phalera* and in our Butterflies the genus *Basilarchia*. It seems to me that the species in these genera present a certain advanced stage of distinctiveness when their interdependence has but recently ceased, they are yet in process of separation, of hardening-into perfectly distinct appearing species. I have called such generic groups, *Progenera*. Sections of other genera, as considered by Authors, show this peculiarity, as the typical section of *Hemileuca*. I refer *tricolor* to *Hemileuca*, and in this view its color variation becomes of more interest than when regarded as a distinct generic type. From this subfamily, as established by Packard, I have separated the *Hemileucinae* and *Ceratocampinae*, the latter the *communiformes* of Hübner, characterized by the shorter antennae and heavy bodies, in this approachning the *Cossidae*, from this latter I separated, as a distinct subfamily, the *Hepialinae*. My Catalogue in the Philosophical Society gives my ideas on the arrangement of these groups, but slightly altered from Packard. On these points the student should consult our colored Plates of *Datana* in the sixth Volume of the Proceedings of the Entomological Society of Philadelphia and the descriptions. On the *Ceratocampinae* consult Grote and Robinson's paper in N. Y. Lyceum. Also my list, Am. Phil. Society, Nov. 20th, 1874, and my papers in the Bulletin of the United States Geological Survey. A period of Renascence in American Entomology has now passed away. It is one hundred years from Linnaeus

X. Edition to Clemens (1858) which date I take as the commencement of an era in which American Lepidopterists are to catalogue the different Families of Lepidoptera and lay foundation for present and future discoveries. Mr. W. H. Edwards describes and catalogues our Butterflies, as also Mr. S. H. Scudder; Dr. Clemens writes on the *Sphingidae*, *Tortricidae* and *Tineidae*, Dr. Packard on the *Zygaenidae*, *Bombycidae* and *Geometridae*, I, myself, catalogue the *Sphingidae*, *Noctuidae* and *Pyralidae*, Mr. C. T. Robinson, besides working with me, commences to figure the *Tortricidae* and Mr. V. T. Chambers takes up the *Tineidae* afresh. Finally Prof. C. H. Fernald catalogues the *Tortricidae* and reclassifies them, Mr. Henry Edwards works up the *Sesiidae* and, with the publication of my New Check List (1882), this Renaissance period comes to an end. These are its principal Authors and their work. It spans the time from Dr. Morris Catalogue to my New Check List. It has identified our more usual forms, arranged them scientifically and in correspondence with the views of the best European writers, besides performing a great deal of original and enduring work of its own. From this time the description of our Butterflies and Moths is undertaken with greater security and this period is further notable from the appearance of a journal, *Papilio*, entirely devoted to the *Lepidoptera*. Above all, the work of determining the private collections throughout the country has been performed and has greatly furthered the interest in the study. The first period of North American Lepidopterology was that of Abbot, Boisduval, the elder Leconte, Say, Peck, Harris, Gosse, Kirtland and their historian, our old friend Dr. J. G. Morris. The second period, which I call the Renaissance, alluding to the re-rising of the study since Say's death, has certainly been a fruitful one, during which a great deal of work was performed with good humor and at considerable selfsacrifice. It deserves a better fate than that any of its workers should have their laurels assailed by those who to day rest in their shade. It is not that very many others do not materially assist, but the writers above mentioned are those who performed the most work in the Butterflies and Moths and whose names

are more particularly associated with the respective families of the *Lepidoptera* of our North American fauna.

As to English names for the American species of Hawk Moths, several have been suggested which I have not referred to here. I, myself, have used the following common names: the Early Bee Hawk, for *Lepisesia flavofasciata*; the Blue and Green Hawk, for *Argens labruscae*; the Particolored Hawk, for *Ampelophaga versicolor*; the Wandering Hawk, for *Dilophonota ello*.

Any approach of the internal feeding *Cossinae* to the Hawk Moths is, I think, unwarranted. In considering the *Sphingidae* as a distinct Family, equivalent to the *Bombycidae* and *Noctuidae*, special studies, such as I have here attempted, must decide as to the rank of the component groups and this on similar considerations as influence our separation of the Family itself. In this action, the definitions of the elder Agassiz must be held steadily in view and we must not wholly depend upon a generic class of characters, as would seem to have been the course of that most distinguished of Entomologists-Lederer.

On the whole the Subfamilies of *Sphingidae* may be regarded as affording two series, the first embracing the *Macroglossinae*, *Choerocampinae* and *Smerinthinae*, the second the *Sphinginae* and *Acherontinae*, the members of each series approaching each other more nearly than the opposed series. Nevertheless the Eyed Hawks afford a synthetic type, the family characters recalling the *Smerinthinae* appearing in all the groups. So the Bee Hawks approach through *Deidamia* and the genera with angulated wings, the Elephant Hawks through *Ambulyx*, the Typical Hawks through *Ellema*. The pattern and colors, outline, habit and general structure, so difficult to properly consider in a linear arrangement, are best appreciated under the present classification. The short antennae of the Death's Head Hawk Moths (*Acherontinae*) seem to me a low character; the pattern and colors, the ringed abdomen, the contrast between primaries and secondaries ally this Old World group with the Typical Hawk

Moths (*Sphinginae*); I have noticed in both a certain reminiscence of the Owlet Moths or *Noctuidae* (*Sphingidae* of Cuba, pp. 1—2).

So strong are the characters of the Bee Hawks with angulated or uneven external margin to the forewings (as seen especially in the larval stages of *Thyreus*, like *Philampelus* where the anal horn is discarded for an ocellus), that I have hesitated as to their position. But their general *form* and body tuftings decide me that they are to be regarded as aberrant *Macroglossinae*, rather than a distinct subfamily type. They make a natural passage between the two subfamily groups, sharing the flight and habit of the one and approaching the other in the young stage and food plant. Upon this latter characteristic, as it generally is for my different subfamily groups of *Sphingidae*, I lay great value as indicating relationship. It unites the *Sphinginae* and the *Acherontinae* and shows that these two are the nearer related and form a series. Everywhere that class of proofs which require the tact and experience of a Naturalist to bring out, witness for that general view of the classification of the *Sphingidae* which I may speak of as my own, so much being either original with me or brought into new light through my long study of the family.

The man of science observes the small changes which underlie the endless succession of life. It is clear to him *how* we are drifting if, with the rest of humanity, he does not know *where*. Within certain limits he believes that the will of man counts for something and that, in the perpetual struggle, that which is useful, good and beautiful shall prevail. Even in comparatively so small a social field as Entomology affords, he may oppose the purely selfish action, the insincere statement, and try to correct the limited experience which prompts so many faults. From the contemplation of much that is paltry and much that is stupid in the writings and doings of Entomologists, he can at least always turn for relief to Nature herself, standing high above all the schools which strive but to translate her. He may drink in all the loveliness of the world and refresh his soul by wanderings

in field and forest, by expansive lake and winding stream. The throbbing Sea, answering by its agitation to the pulses of the wind, will excite his longings and draw his soul out after it. And, when the summer is past and the roses, by thousand ways and voices, Nature will still amuse him until, tired of his quest, he falls into the last sleep in the arms of the universal mother.

So, by the Lake at Buffalo, Time, winged with happiness passed by and, feigning that he would be thus everywhere, lured me away. The world is full of beautiful butterflies but those that fly at home are the best. Even in the technical works of our noted Entomologists, a local coloring attests the force of this sentiment. Thus there is an indescribable Massachusetts flavor about Dr. Harris's book. And, let him industriously gather eggs and caterpillars from what part of the country he may, it is always as from West Virginia that Mr. W. H. Edwards invites his readers to the great feast of facts. In some way the scent of the Maine woods has got into Professor Fernald's writings: we seem to know the famous bog in Orono, whereon *Oeneis jutta* cumbrously flies; through openings in the woods we catch a glimpse of warm-tinted Spring-tide azalea or shall-bush blooms, over which the "Early Bee Hawk" (*Lepisesia flavofasciata*) for an instant hovers to vanish again. And the ridge by the Lake side where, of a June evening, I caught the rare "Particolored Hawk" (*Ampelophaga versicolor*) I would also have remembered out of my own experiences, the Canada shore in the distance and all about me the lovely scenery of Western New York.

Although what the Poets say must always be taken in a certain wide sense, I have been struck by their particular attention to butterflies. Poe declares that a certain curious sentiment is derived from "the contemplation of a moth, a butterfly, a chrysalis." As to the latter he may have been influenced by the mere euphony of the word itself. Only an Entomologist, with prophetic soul dreaming on the glories to come, can be moved by the sight of a chrysalis. But, perhaps, I am wrong here, remembering the chrysalids of

certain butterflies, those pendant, gold-studded earrings of Nature, hung by her in moments of pride from trees and pretty blooming plants. Buds to open, to expand, to take their flight.

Sometimes, now, I dream of fields Elysian, where, on beds of Asphodel, hang pendulous immortal butterflies, beneath an eternal sky. And, coming kindly to meet me, I see Harris and Doubleday, Boissieu and Say; while, with his nervous manner all gone, I find again Francis Walker, his good work all remembered. And he forgives all I have said, as I ask his pardon, because it really was (and I have been there myself) very dark in the entresol of the British Museum where he had to work. But here it is Light at last and an everlasting Sun is shining.



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